

**State of Rhode Island
Department of Environmental Management**

Rhode Island Guideline



for

Air Quality Modeling for

Air Toxics Sources

Revised Edition
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Glossary of Acronyms and Symbols

AAL	Acceptable Ambient Level
ATOP	Air Toxics Operating Permit
BCRP	Building Cavity Region Program
CAALs	Calculated Acceptable Ambient Levels
CEM	Continuous Emission Monitoring
EPA	Environmental Protection Agency
g/sec	Grams per second
GEP	Good Engineering Practice
hr/yr	Hours per year
lb/hr	Pounds per hour
LAER	Lowest Achievable Emission Rate
µg/m³	Micrograms per cubic meter
OAR	Office of Air Resources
σ_{yo}	Initial horizontal sigma or dimension
σ_{zo}	Initial vertical sigma or dimension
SCRAM	EPA's Support Center for Regulatory Air Models
USGS	United States Geological Survey
UTM	Universal Transverse Projection

Definitions

Air contaminant: A substance emitted to the atmosphere as dust, fume, gas, mist, smoke, vapor, or soot which may adversely affect human health or welfare, animal life, vegetation, or property.

Ambient air: The portion of the atmosphere to which the general public has access.

Background: Air contaminant concentrations present in the ambient air that are not attributed to the source or site being evaluated.

Exceedance: In excess of a pre-established comparison level.

Emission point: Point of air contaminant release into the air.

Facility: All pollutant-emitting activities which belong to the same industrial grouping, are located on one or more contiguous or adjacent properties, and are under the control of the same person (or persons under common control). Pollutant-emitting activities shall be considered as part of the same industrial grouping if they belong to the same "major group" (i.e. which have the same two-digit code) as described in the Standard Industrial Classification Manual.

Model: A quantitative mathematical representation or simulation that uses building, stack, emissions and meteorological information to predict the impact of air contaminants emitted by one or more sources on ambient air.

Property: All land under common control or ownership coupled with all improvements on such land and all fixed or movable objects on such land, or any vessel on the waters of this state.

Receptor: A location where the public could be exposed to an air contaminant in the ambient air.

Refined model: A model that provides a detailed treatment of physical and chemical atmospheric processes and requires detailed and precise input data. The outputs are more accurate than those obtained from conservative screening techniques.

Screening technique: A relatively simple modeling technique to determine whether a given source is likely to pose a threat to air quality. Concentration estimates from screening techniques are conservative.

Site: The area that encompasses all emission sources of air contaminants.

Source: A point of origin of air contaminants, whether privately or publicly owned or operated. When used in the context of modeling, the term source refers to the release point of emissions.

Stationary source: An emission point that is fixed and not mobile. For example, exhaust from a stack or baghouse is from a fixed point, and exhaust from a car is from a mobile source.

because the exhaust moves as the car does.

1.0 INTRODUCTION

The purpose of this guideline is to standardize the procedures used for air quality modeling to determine compliance with the air toxics limitations in Rhode Island Air Pollution Control Regulations No. 9 and No. 22. This guideline should not be used to meet Clean Air Act, RCRA, or any other federal requirements that invoke the EPA's Guideline on Air Quality Modeling¹.

To obtain an air toxics operating permit (ATOP), Subsection 22.5.3 of Regulation No. 22 requires a demonstration that emissions from a facility will not cause an increase in the ground-level concentration of an air toxic in exceedance of the Acceptable Ambient Levels (AALs) listed in that regulation and in Appendix A of this document. New sources must make a similar demonstration for both listed and non-listed air toxics to obtain a permit to construct, install or modify. The Rhode Island Department of Environmental Management, Office of Air Resources (OAR) develops Calculated Acceptable Ambient Levels (CAALs) for evaluating impacts of non-listed air toxics from new sources, in conjunction with permit applications.

Demonstrations of compliance with AALs and CAALs require the use of air quality modeling techniques. Information about emissions, stacks, building dimensions and meteorology is input into the model, which then mathematically simulates the dispersion of the pollutant and estimates the concentration of that pollutant which would occur as a result of those emissions at various distances downwind of the source. Since the AALs and CAALs refer to the increase in concentration of a pollutant associated with emissions from a facility, background levels of the pollutant are generally not considered.

This guideline recommends specific modeling procedures, but cannot anticipate every potential situation. Modeling in conjunction with the issuance of ATOPs is generally performed by OAR staff. In cases where this guidance is used by facilities or their contractors, the applicant should submit a modeling protocol to the Office of Air Resources before undertaking the modeling analysis. This is particularly important if refined modeling is necessary or if the applicant plans to deviate from using the models or procedures specified in this document. General guidance on dispersion modeling is also found in EPA's Guideline on Air Quality Models¹ and the models discussed in this document, along with accompanying User's Guides, are available on the EPA's Support Center for Regulatory Air Models (SCRAM) website, <http://www.epa.gov/scram001>.

This guideline presents an approach to air modeling which begins with the collection of basic source information. The modeler then calculates Good Engineering Practice (GEP) stack height, performs a building cavity analysis, and uses a screening model to predict downwind impacts. Screening models are relatively easy to run and are designed to produce conservative (i.e. biased high) downwind concentration estimates by using simplifying assumptions in combination with worst case meteorology. In many cases, a screening analysis provides an adequate demonstration of compliance with AALs. If such a demonstration cannot be made using simple screening procedures, then a refined analysis using actual hourly meteorological data is necessary.

The September 2004 revisions to this guideline are effective immediately, with the exception of the specification in Section 5.0 that the AERMOD-PRIME model must be used for refined modeling. Refined modeling in connection with any permit application or permit renewal application submitted or due to be submitted on or after 1 January 2005 shall be done using AERMOD-PRIME, as specified in Section 5.0.

2.0 REQUIREMENTS FOR AIR QUALITY ANALYSIS

This section gives an overview of the components of a modeling study. Details regarding modeling techniques are discussed in the sections that follow.

2.1 Facility Data

Obtaining accurate and complete facility data is essential for accurate modeling results. The following information is required for most air toxics modeling demonstrations:

- A site plan, to scale and with a North arrow, showing the property boundaries, all building dimensions, grade elevations, stack locations, stack base elevations and stack heights suitable for a Good Engineering Practice (GEP) analysis.
- A description of the equipment or process which is emitting air toxics.
- For each emission point:
 - Is the release through a vertical stack, a horizontal stack or vent, or is it a fugitive release through windows and/or doors?
 - If the release is through a stack, the inside diameter at stack top; stack height; and whether stack has a raincap. If the stack is rectangular, an effective stack diameter (the diameter of a circle having the same area as the rectangular inside opening) must be calculated using the following equation:
$$\text{Effective diam. (m)} = (4 \times \text{opening width (m)} \times \text{opening length (m)} / \pi)^{1/2}$$
 - If the release is not through a stack, the location and size of the opening.
 - Which air toxics are emitted.
 - For both maximum and typical operating load conditions, the pollutant emission rate (lb/hr), stack gas exit temperature and stack gas exit velocity.

- The operating schedule for the process(es) that emit air toxics in hours/day, days/week and weeks/year.
- A topographical map out to 10 km from the source.
- A determination of whether the source is in an “urban” or “rural” area for modeling purposes according to the specifications in subsection 8.2.8 or the EPA’s Guideline on Air Quality Models¹, which is available on the SCRAM website. The Guideline recommends that this determination be based on either land use or population density within a 3 km radius of the source. However, since the maximum impacts usually occur relatively close to air toxics sources, a review of the area immediately surrounding a facility is most important.

All emission sources under review should be modeled at both maximum and typical operating load conditions. If compliance with regulatory limits can be demonstrated at typical operating load conditions but not at maximum load conditions, load restrictions may be stipulated in permits.

2.2 GEP Analysis

For each stack or emission point, a Good Engineering Practice (GEP) stack height determination must be performed in accordance with EPA Guideline for Determination of Good Engineering Practice Stack Height (Revised)², which is available on the SCRAM website, and the definitions in EPA’s “Stack Height Regulations, Final Rule.”³ For sources that are near more than one building or buildings with multiple roof heights, the building with the greatest GEP height is said to be the “controlling building” or “controlling tier” and is the one used in screening modeling. For refined modeling, a more detailed GEP analysis is required in which the controlling building (its height and width perpendicular to the wind) is identified for each of 36 different wind directions, starting with North and spaced 10° azimuth around the compass. In this case, the controlling building may change for different wind directions. When refined modeling is anticipated and more than one building is involved, the U.S. EPA Building Profile Input Program (BPIP)⁴, which is available on the SCRAM website, should be used.

2.3 Cavity Analysis

If all emission points are at or above the GEP stack height, a cavity analysis is not performed. Otherwise, it must be assumed that some portion of the emissions may be trapped in a downwash recirculation cavity behind nearby buildings. As concentrations in these cavities can be relatively high, due to the limited air volume into which pollutants are mixed, the objectives of a cavity analysis are: (1) to determine if the cavity extends beyond a facility’s property line for any wind direction, and if so then (2) to determine if the maximum concentrations in the cavity exceed any AAL for 1-hour, 24-hour or annual time periods.

Guidance on cavity modeling techniques is given in Section 3. Compliance with the AALs in the cavity analysis does not eliminate the need to do dispersion modeling for areas outside of the downwash cavity.

2.4 Screening Modeling - Wake Region

Screening modeling is a relatively simple procedure used to conservatively calculate concentrations outside cavity regions (in the wake region) at receptors on and beyond a facility's property line. If predicted concentrations are less than the AALs or CAALs for those pollutants, no further analysis is required. If predicted impacts exceed an AAL by a factor of less than 10, refined modeling techniques, which generally reduce estimated impacts, may be used. If the impacts predicted by screening modeling exceed the AAL or CAAL by a factor of 10 or more, it is very unlikely that refined modeling would demonstrate compliance, and the facility will be asked to submit a plan for reducing emissions or improving dispersion characteristics before additional modeling is undertaken. Screening modeling must consider receptors in both simple and complex terrain, the latter being elevations above stack top. Guidance on screening modeling techniques is given in Section 4 of this document.

2.5 Refined Modeling - Wake Region

A refined model provides a more detailed analysis of the process of transport and dispersion of emissions from one or multiple sources and predicts impacts from those emissions at a large numbers of receptor points downwind. Refined modeling requires either one year of hourly meteorological data collected on-site or five full years of hourly data from a representative National Weather Service site. If there is a violation of an AAL, the source will need to submit a plan for reducing ambient impacts. This plan might include reducing emissions through process modifications or changing stack parameters. Refined modeling must consider receptors in both simple and complex terrain. Guidance on refined modeling techniques is given in Section 5.

2.6 Modeling to Determine Maximum Allowable Emissions

In addition to determining compliance with AALs and CAALs, modeling can be used to calculate the maximum allowable emissions rate of a pollutant allowed for a facility.

If the pollutant is emitted from only one source at the facility, maximum allowable emissions rate is calculated according to the following formulas:

$$\text{Max Allowable Emiss. (lb/hr)} = \left[\frac{1\text{-hr AAL } (\mu\text{g/m}^3)}{\text{Modeled Emiss. Rate (g/sec)}} \right] * 7.94 \text{ lb/hr / g/sec}$$

$$\text{Max Allowable Emiss. (lb/dy)} = \left[\frac{24\text{-hr AAL } (\mu\text{g/m}^3)}{\text{Modeled Emiss. Rate (g/sec)}} \right] * 7.94 \text{ lb/hr / g/sec} * 24 \text{ hr/dy}$$

$$\text{Max Allowable Emiss. (lb/yr)} = [\text{annual AAL } (\mu\text{g}/\text{m}^3) / \text{Max Modeled Annual Impact } (\mu\text{g}/\text{m}^3)] \\ * \text{Modeled Emiss. Rate (g/sec)} * 7.94 \text{ lb/hr} / \text{g/sec} * 8760 \\ \text{hr/yr}$$

If more than one source at the facility emits the pollutant, the dispersion characteristics of the sources may not be equivalent, and this fact must be considered when calculating maximum allowable emissions rates.

To calculate the most accurate maximum allowable emissions rate, refined modeling, rather than screening modeling should be used for the non-cavity region. However, refined modeling is not necessary when the maximum ground-level concentration in the cavity region is greater than the value predicted in the non-cavity region using screening modeling or if the facility can agree to limit its emissions to less than the maximum allowable emission rate, calculated using the screening modeling results.

2.7 Land Use Considerations

Regulation No. 22 allows OAR to exempt impacts in areas that are not accessible to the public from consideration when determining compliance with AALs. OAR may also consider impacts on a facility's property if public access to that area of the property is not restricted. In addition, OAR may, at its discretion, adjust annual or 24-hour AALs used to evaluate the impacts in areas where, due to land-use considerations, public exposure potential is limited. For example, exposures in industrially zoned areas are generally limited to 40 hours per week, as compared to the potential for continual exposures in residential areas. A facility that wishes to exclude an area from a modeling analysis or to apply a less stringent AAL to an area where exposure opportunities are limited should supply documentation to OAR that demonstrates land-use restrictions in those areas.

3.0 BUILDING CAVITY MODELING TECHNIQUES

Short stacks and vents on the sides and roofs of buildings can cause relatively high concentrations in the recirculation cavity behind a building. The length of this cavity is measured from the lee side of the building. As a first cut, the Schulman/Scire option in EPA's SCREEN3 model should be used to evaluate pollutant impacts in the cavity region. The SCREEN3 model is available for download on the SCRAM website.

The first task is to identify which, if any, of the building cavities extend beyond a facility's property line and which, if any, stacks contribute to pollutant concentrations in these cavities. A portion of the emissions from a less than GEP height stack should be assumed to be caught in a building's cavity region if the stack is attached to the building under evaluation or is less than 2 L_b upwind of the building (where L_b is the smaller of the building height and width), $1/2 L_b$ from the sides of the building, or within L_R (the recirculation cavity length) downwind. L_R is calculated by the Schulman/Scire option of SCREEN3. Emissions from horizontal stacks, vents

that are essentially flush with the roof or sides of a building, doors and windows and other fugitive sources should always be assumed to be captured in the building cavity.

Estimating the cavity lengths for four wind directions, each normal to one of the building faces, is generally sufficient for determining if any cavity regions extend off site. However, off-axis cavity regions may also have to be considered, depending on the shape of the property. Direction-specific building dimensions must be used to determine the extent of off-axis cavity regions. The Office of Air Resources has developed a computer program called BCRP (Building Cavity Region Program) that performs this task. This program displays building cavity regions and their relationship to facility property boundaries for thirty-six wind directions and can be used to determine if a cavity analysis is necessary. The BCRP program and user's guide can be obtained free of charge from the Office of Air Resources by calling (401) 222-2808 or by sending a written request.

Building cavity models assume a simple block-like building. For buildings that are not square, a four-sided footprint of the building should be used for the cavity analysis. Emissions from non-vertical stacks, vents or other fugitive sources can be modeled with the SCREEN3 model by using a point source with an exit velocity of 0.001 m/s and holding the flow rate constant. This procedure eliminates plume rise from momentum. If the release height is lower than the building's roofline, the release should be modeled at the actual release height using the "stack **not** on structure" option of the SCREEN3 Schulman/Scire cavity analysis.

When there are multiple buildings or building tiers or multiple sources, the modeler must identify all sources that add pollutant mass to the cavity region of each building or tier. In the case of a multi-tiered building, one approach is to use a simple block structure that simulates the general shape of the building complex. Another approach is to model each building tier separately and determine which tier causes the greatest impact. Modelers using that approach should be aware that modeling a single tall narrow tier without considering short wider tiers could produce unreasonable concentration results.

In general, the impacts from individual building cavities should be modeled separately and the greatest predicted impact used to determine compliance. If cavity impacts for different sources at a facility overlap, then the concentrations for the same air toxic should be summed to determine impacts in the overlapping regions. For the case of multiple stacks in the same building cavity emitting the same air toxic, each stack should be modeled separately and the results summed to obtain a total cavity concentration.

Predicted concentrations in cavity regions that extend beyond the facility's property line should be compared to the Regulation No. 22 Acceptable Ambient Levels (AALs) and, for preconstruction applications, to any CAALs developed pursuant to Regulation No. 9 requirements. The modeled concentrations are one-hour averages, and should be compared to the AALs for that averaging time. To simplify the analysis for situations which involve more than one stack or building, the maximum one-hour concentration of a pollutant in all applicable cavity regions can be summed and the sum compared to the one-hour AAL.

Impacts in cavity regions that extend off-site should also be compared to 24-hour and annual average AALs. Since SCREEN3 predicts only one-hour impacts, the following method should be used for this comparison:

- Compare the one-hour cavity impact determined as discussed above to the appropriate 24-hour and/or annual AAL.
- If the one-hour impact does not exceed the 24-hour AAL and the one-hour impact multiplied by 0.30 does not exceed the annual AAL, then the source has demonstrated compliance.

If a facility cannot demonstrate compliance with the AALs in the cavity regions using SCREEN3, refined cavity modeling can be conducted using the AMS/EPA Regulatory Model with the PRIME algorithm (AERMOD-PRIME) dispersion model. This model is discussed further in Section 5 of this document. This option may also be chosen initially instead of SCREEN3, particularly if refined modeling is necessary for the wake region or if multiple sources and/or buildings are involved in the analysis.

4.0 SCREENING MODELING – WAKE REGION

The EPA SCREEN3 model should be used for screening level modeling of point, area and volume sources to calculate non-cavity concentrations at receptors in simple terrain (elevations below stack top). As discussed in subsection 4.7 below, SCREEN3 should be run with the model's VALLEY complex terrain screening option when receptors in complex terrain (elevations at or above stack top) are present.

4.1 Time Scaling Factors - SCREEN3

SCREEN3 predicts maximum one-hour concentrations at defined receptors. Concentrations for longer averaging times can be obtained by multiplying the one-hour concentration generated by SCREEN3 by the factors in the following table.⁵

Averaging Time Desired	Multiply One-Hour Concentration by:
3 hours	0.9
8 hours	0.7
24 hours	0.4
Annual	0.08

4.2 Receptor Locations - SCREEN3

In SCREEN3, receptors are assumed to lie downwind along the centerline of the plume from a single source. Thus only one wind direction is modeled. The receptors should be spaced no

farther apart than 100 meters in the first 2000 meters downwind, and the first receptor point should be placed at the closest distance the source lies to the property boundary. For high stacks, receptors beyond 2 km out to 10 km may be appropriate for the initial modeling runs. If the model grid does not include receptors with elevations at or above the stack top, the length of the grid should be extended to include such receptors or the modeler should demonstrate that the terrain beyond the grid would not cause higher impacts at more distant receptors. Once a maximum impact is found, additional receptors at 10 meter spacing around this point should be analyzed to ensure that there is no significant terrain just beyond the maximum impact receptor.

The terrain height for each receptor is obtained from reading U.S. Geological Survey topographical maps. A set of concentric circles should be drawn on the maps corresponding to the receptor distances from the source. The single terrain height for each receptor should be selected as the highest terrain that occurs anywhere in the area bounded by:

1. The circle in which the receptor is located and the next larger concentric circle and
2. The two radii connecting the center of the concentric circles with the points halfway between the receptor and the receptors on both sides of the receptor.

By this method, every point on the map is examined in assigning maximum terrain heights to the receptors. If the initial screening runs show an exceedance of an AAL or a CAAL, the model can be run again with a more refined grid using actual receptor elevations in the vicinity of the point where the exceedance occurred.

The user should take special note that the SCREEN3 model does not ask for stack base elevation (meters above Mean Sea Level); the model assumes the stack is at a base elevation of 0 meters. Thus, one can not directly enter terrain elevations taken from U. S. Geological Survey maps into SCREEN3. The user must first subtract the stack base elevation from the terrain elevation to get the relative rise of terrain above stack base. This is what the model expects. All elevations are in meters, not feet.

Simple terrain is land that is above stack base elevation but not higher than stack top. In SCREEN3, the user is given the choice of modeling simple terrain or flat terrain. Flat terrain should be selected when none of the receptor terrain heights exceed the stack base elevation. For example, a stack sitting on top of the highest hill would be modeled as flat terrain. For simple terrain, the SCREEN3 model prompts for a terrain height above the stack base elevation and uses this single number for making calculations at the entire group of receptors, whether the receptors are chosen with the automated array option or specified as discrete receptors. By requesting multiple sets of receptors, the modeler can enter more than one terrain height into the calculations.

The SCREEN3 model also asks for the receptor height above ground. This is not the height of the terrain, but rather is the height of the receptor above the ground-level elevation. Generally, the receptor height above ground is set equal to zero, meaning all receptors are at ground level. If a non-zero value is used, then all receptors will be assumed to be floating at this height above their respective ground-level elevations. An example of when this option might be used is when

pollutant concentrations need to be known at open windows or at fresh air intakes on top of buildings.

4.3 Point Sources -SCREEN3

Although the SCREEN3 model is only designed for single sources, the impacts from two or more point sources can be conservatively estimated by modeling each singly and then adding the maximum concentrations together, regardless of the associated downwind distances. This is a useful approach when individual impacts are small and compliance with regulatory standards can be easily demonstrated without using a refined model. The emissions from multiple stacks which are located within 100 meters of each other and which have volumetric flow rates that differ by no more than 20% can also be merged using the following procedure⁵:

Step 1 Compute the parameter M for each stack to be merged where:

$$M = (H_s * Q * T_s) / E$$

Where,

M = merged stack parameter

H_s = stack height above ground (m)

Q = volumetric Flow Rate ($\pi D^2/4$)V, (m³/s)

D = effective stack exit inside diameter, (m)

P = π

V = stack gas exit velocity, (m/s)

T_s = stack gas exit temperature, (°K)

E = pollutant emission rate, (g/s)

Step 2. Determine which of the stacks has the lowest value of M. This is the representative stack.

Step 3. Sum the emissions (E) from the stacks that are being merged. This summed emission rate along with the stack parameters for the representative stack should be used in modeling the merged stacks.

For the case of horizontal stacks or vertical stacks with raincaps, the exit velocity should be set to 0.001 m/s to eliminate plume rise from momentum, while the actual flow rate is held constant. In order to maintain the actual flow rate for vertical rain-capped stacks, the modeled stack diameter must be different from the actual stack diameter. The modeled stack diameter for vertical rain-capped stacks should be calculated using the following equation:

$$d_m = d_a (V_a/V_m)^{1/2}$$

where:

d_m = modeled stack diameter;

d_a = actual stack diameter;

V_m = modeled stack exit velocity, i.e., 0.001 m/s; and

V_a = actual stack exit velocity.

If building downwash is to be considered, no stack tip downwash correction is made by the model. When building downwash is not to be considered, however, the model does make a stack tip downwash correction and the modeled stack diameter should be set equal to the actual stack diameter in order to avoid unrealistically small modeled stack heights.⁶ For horizontal stacks, the modeled stack diameter should be set equal to 1.0 meters.

Flares, such as those used to burn landfill gas, are modeled as elevated point sources. The technique to calculate buoyancy flux for flares generally follows the technique described in the SCREEN3 Model User's Guide⁷, which is available on the SCRAM website.

The following parameters should be used when modeling flares:

- Emission rate (g/s)
- Flare stack height (m)
- Total heat release rate (cal/s)
- Receptor height above ground (m)
- Urban/rural option (U = urban, R = rural)

4.4 Volume Sources - SCREEN3

The SCREEN3 model should also be used for the screening analysis of the non-cavity impacts of emissions from vents, along the faces and roofs of buildings, through doors and windows and in similar situations. These releases are best represented by a volume source having the dimensions of the building from which the emissions originate. Very short vertical stacks on buildings, those for which the stack height to building height ratio is below 1.2, can also be modeled as volume sources for receptors beyond the cavity region.

Volume sources must have a square base, but need not be a cube. For a square, or nearly square, source the actual building dimensions (height and width) should be used for the screening analysis. For non-square sources, the width of the source should be set equal to the minimum building length.

A volume source is defined by its release height (HS) and initial lateral and vertical dimensions, σ_{y0} and σ_{z0} respectively. The release height is the center of the volume source and so it should be set equal to one-half the average building height. The initial lateral dimension for a volume source should be set equal to its width divided by 4.3. The initial vertical dimension for a volume source should be set equal to the average building height divided by 2.15.

The location and elevation of receptors should be determined for volume sources in the same manner as for point sources. The downwind distance used in the model is measured from the center of volume source, not its edge. The modeler should be careful in measuring the distance to the first receptor.

4.5 Area Sources - SCREEN3

The SCREEN3 model should be used for a screening analysis of the impact of emissions from area sources such as landfills, surface impoundments, wastewater lagoons, tank farms, and other chemical storage areas. The release height should be set to zero, except in the case of tank farms and storage areas, where the release height should be set to the average height of the chemical release.

The downwind distance used in the model is measured from the center of the area source, not its edge. The modeler should be careful to measure the correct distance from the center of the area source to the nearest property line in setting the first receptor distance. Generally the receptor distance should not be less than the length of one side of the area source.

4.6 Screening Evaluation of Facilities with Combinations of Point, Area, and Volume Sources

The SCREEN3 model should be used for the screening analysis of the impact of emissions from facilities having combinations of point, area, and volume sources. All sources should be collocated and the impacts at each receptor due to each source should be summed. The modeler should remember that receptor distances are measured from the center of volume and area sources, not from the edge. If sources would not be realistically collocated, refined modeling may be more appropriate.

4.7 Complex Terrain Modeling - Screening Evaluation

When conducting screening modeling analyses for point sources, complex terrain modeling techniques should be used for receptors with elevations higher than the top of a stack being modeled. To model this situation, the complex terrain option in the SCREEN3 program (VALLEY) should be selected. As discussed above, VALLEY generates a 24-hour concentration, which can be scaled to a 1-hour concentration by multiplying by a time scaling factor of 4.0. Hourly meteorological data are not required for the VALLEY model.

VALLEY allows the plume centerline to come as close as 10 meters to the ground and calculates the Distance to Final Rise and the Final Stable Plume Height. Presuming that complex terrain exists closer to the stack than the Distance to Final Rise, receptors modeled should be located at distances less than the Distance to Final Rise and at terrain elevations between the stack height and the Final Stable Plume Height minus ten meters. These receptors should be analyzed in one meter increments of elevation. The locations of these one meter increments should be interpolated from topographical maps where necessary.

Generally the highest VALLEY concentration will be predicted where the terrain elevation is at least as high as the plume height minus 10 meters. Both terrain and plume height vary with downwind distance, although the plume eventually levels off. When searching for the maximum impact in complex terrain, the modeler needs to be aware of not only the change in terrain height with distance, but also the change in plume height.

If the terrain is above stack height but below the height of the plume centerline, SCREEN3 makes two calculations - (1) a 24-hour VALLEY estimate as described above which assumes a 1 to 24-hour time scaling factor of 0.25, and (2) a 24-hour simple terrain model estimate across a full range of meteorological conditions which assumes a 1 to 24-hour time scaling factor of 0.4. The terrain is chopped off at stack height in the simple terrain calculation. The SCREEN3 output prints out columns of both estimates and the higher of the two estimates. The higher of the two estimates should be used for comparison with AALs or CAALs in screening analyses. If the terrain is at or above plume height, only the VALLEY calculation is shown. It should be noted that neither the complex terrain calculations nor the simple terrain calculations consider building downwash effects when the VALLEY option is selected.

Alternatively, the source can be modeled in simple terrain using the refined modeling techniques discussed in Section 5 of this document and the output of that modeling, along with the VALLEY output, compared to the AALs and CAALs. If that procedure is chosen, the SCREEN3 output from the simple terrain model need not be considered.

The 24-hour complex terrain concentrations output by the VALLEY option of SCREEN3 can be converted to 1- or 3-hour averaging periods by multiplying by 4.0. 24-hour complex terrain concentration outputs from the simple terrain calculation discussed above should be converted to 1- or 3-hour averaging periods by multiplying by 2.5. Annual average concentrations can then be calculated by multiplying the one-hour concentrations by 0.08. If an 8-hour concentration in complex terrain is needed, the 24-hour concentration should be multiplied by 3.0 (plume impaction for 6 hours followed by 2 hours of no impaction).

5.0 REFINED MODELS

The AMS/EPA Regulatory model with the PRIME downwash algorithm (AERMOD-PRIME) should be used for refined modeling of air toxics releases. Effective July 1, 2005 AERMOD-PRIME must be used to predict the impact of emissions from any combination of point, area and volume sources for one-hour, 24-hour and, annual averaging periods at user-defined receptors. Either one year of on-site meteorological data or the most recent five years of meteorological data from a representative National Weather Service site should be used in the model. Representative meteorological data can be obtained from the Office of Air Resources free of charge by calling 222-2808 or sending a written request. Facilities who plan to collect on-site meteorological data for use in modeling should meet with OAR prior to beginning data collection to discuss siting criteria, parameter selection, instrumentation, data processing, quality control measures and other factors relevant to collecting data that will be appropriate for modeling purposes.

Appendix B contains a checklist for refined modeling. This checklist should be used for both new modeling and the review of existing modeling.

Refined modeling should be attempted only by people who are well trained in dispersion modeling techniques and are familiar with AERMOD-PRIME and its extensive data

requirements. The selection of model options for refined modeling should follow specific guidance given by EPA. Both the model and a user's manual are available on the SCRAM website.

5.1 Receptor Locations - AERMOD-PRIME

Receptor networks are of two common types - polar and Cartesian. In a polar network, concentric rings and radials spaced every 10° extend out from a center point (the emissions source). Receptors are located where the rings and radials intersect; a minimum of 360 receptors (10 rings) should be used. In a Cartesian network, a rectangular grid is used and should contain a minimum of 400 points (20 X 20). The polar grid is the easiest to use and is recommended. Terrain heights and receptor spacing should be selected as discussed in Section 4.2 of this document. Refined modeling should always include at least two runs; the first to identify the general area of the maximum concentration, and the second with a finer scale grid (10m spacing) to pinpoint the highest concentration. For most air toxics sources, maximum impacts are predicted very close to the source and, therefore, receptors placed along the property line may experience the highest concentrations.

Since an excessive number of receptors will lead to an unreasonably long run time on the computer, it is best to select receptor distances for refined modeling by first running the SCREEN3 model. Receptors should be spaced farther apart as distance increases, since the greatest concentration gradients usually occur close to a source. For example, a possible set of initial ring distances is the geometric progression: 0.1, 0.2, 0.5, 1.0, 2.0, 5.0, 10., 20., 50. km. Run SCREEN3 with meteorology option (2) and a single stability class six separate times, for classes A through F. For each stability class, identify the distance where the 1-hour maximum concentration occurs and the range of distances over which impacts close to the maxima (i.e., +/- 10 percent) occur. Long-term (annual) impacts will be determined primarily by the meteorological conditions that occur most often; in the case of New England, this is stability class D.

In summary, select ring distances as follows:

- Distances where 1-hour maxima occur for each stability class.
- Distances where concentrations close to the maxima occur for the most frequently occurring stability class (D).
- Distances where the highest terrain features occur.
- The closest fence line or property line inside of which public access is restricted.

5.2 Complex Terrain Modeling - Refined Analysis

For receptors located above stack top, a separate analysis of point source impacts using a complex terrain model is required. Since the data requirements for refined complex terrain

modeling are quite extensive, the Office of Air Resources prefers that modelers first run the VALLEY option of SCREEN3 using the procedures discussed in Section 4.7 of this document.

The simplest approach for refined modeling of complex terrain is to use AERMOD-PRIME with the same meteorological data to predict impacts at all receptors in simple, intermediate, and complex terrain. The meteorological data, which is equivalent to that used in SCREEN3, can be obtained from the Office of Air Resources. The wind profile exponents for stable conditions in AERMOD-PRIME should be disabled so that the lowest wind speed class is used for these stability classes.

A more refined approach is to model simple terrain impacts using actual representative meteorological data, and intermediate and complex terrain using the screen meteorological data. The maximum impacts from the two runs should be compared in order to determine the greatest impacts for all receptors.

5.3 Point Sources - AERMOD-PRIME

Vertical stacks that are greater than 1.2 times the height of the building to which they are attached should be treated as point sources. The results of the GEP analysis are needed to specify the actual projected building width and height for the controlling tier corresponding to thirty-six different wind directions.

Refined modeling uses a slightly different approach to model horizontal stacks and vertical stacks with rain caps than in screening modeling. As is the case in screening modeling, the exit velocity of such a stack is set to 0.001 m/s while the flow rate is kept constant by adjusting the modeled diameter (see Section 4.3). When modeling this scenario, the stack tip downwash option in AERMOD-PRIME should be turned off and the stack height of vertical stacks only should be reduced by three times the actual stack diameter in order to account for stack tip downwash (with the minimum value equal to ground level). This approach may not be valid for large diameter stacks, i.e., several meters.³ For horizontal stacks, the modeled diameter should be set equal to 1.0 meter. However, stack tip downwash is not appropriate when modeling horizontal stacks and no correction should be made to the stack height.

Refined modeling for open flares should use the parameters presented in Section 4.3.

5.4 Volume Sources - AERMOD PRIME

Refined modeling analyses of non-cavity impacts of volume sources such as emissions from vents, along the faces and roofs of buildings, through doors and windows and in similar situations should also use AERMOD-PRIME. With that model, it is possible to use multiple volume sources to more accurately represent the geometry of a building complex. The general approach is to sub-divide the building's footprint into a number of smaller elements, each of which is essentially square. For square or nearly square footprints, a single volume source should be used.

Volume sources must have a square base, and for simplicity the multiple squares used to approximate a complex building's footprint should all have the same dimension. For rectangular buildings, the side of the square should be roughly equal to the minimum footprint dimension. A good rule of thumb is that the total area of the volume sources should be less than or equal to the area of the building's actual footprint. This will ensure that the initial dilution volume is not over-estimated (and concentrations under-estimated). The selection of the number and size of volume sources is left to the good judgment of the modeler following this guidance. The volume sources should be placed to best represent the features of the actual building. Total building source emissions should be divided equally among the number of volume sources. Calculation of the initial lateral and vertical dimensions, and the source release height, should follow the guidance in Section 4.4.

5.5 Area Sources - AERMOD PRIME

The refined analysis of impacts of emissions from area sources such as landfills, surface impoundments, wastewater lagoons, tank farms, and other chemical storage areas should also use AERMOD-PRIME. The release height should be set to zero, except for tank farms and storage areas where the release height should be set to the average height of the chemical release.

The refined modeling of area sources is similar to that of volume sources, except that the release height is either at or near ground level. Therefore the modeling guidance described in Section 5.4 should be followed for area sources also.

6.0 MODELING REPORTS

The results of an ambient air quality impact analysis must be submitted to the OAR for review and approval. The information submitted must be in report format and include sufficient information for the OAR to duplicate the results. All input information must be independently verifiable by the OAR and all assumptions made in the establishing of input parameters must be listed and supported. This section outlines the requirements for modeling reports submitted to the OAR.

A. Control Parameters

Model Selection

The report must identify the model used. If model selection deviated from the recommendations in this guidance, the report should include a justification for the use of the alternative model.

B. Input Parameters

1. Emission Rates

A table or list must be provided in the modeling report listing all worst-case and average emission rates used for each pollutant and averaging period. If existing or proposed permit restrictions were used to establish the emission rates used in the modeling, these must be listed and explained. Any emission factors used to calculate emissions rates must be listed, and the source of those factors must be identified. Source specific emissions data, such as stack sampling or CEM data, used to establish emission rates must be documented. Procedures and reference methodologies must be listed.

2. Stack Parameters

For each stack modeled, the height, exit diameter, exit velocity, exit temperature, and stack base elevation must be listed. Where calculations are necessary to establish these parameters, such calculations must be shown. Where this information is obtained from a source other than the OAR, the contact person and telephone number should be included.

3. Site boundary information and information on areas where public access is restricted.

4. A plot plan showing the fenceline or property line of the facility must be provided.

5. Building Parameters

Building parameters including the height, width, length and projected width of every structure influencing each stack modeled must be listed. Calculations of projected widths must be shown. When computer programs are used to determine building dimensions, the software manufacturer, software name and version number and the input and output file listings must be provided. Drawings for each building must be included and must be sufficient to verify the parameters used in modeling.

6. Meteorological Conditions

Screening meteorological conditions used in modeling must be listed in the submitted report. If meteorological data collected on-site are used for refined modeling, those data should be submitted in ASCII format on a diskette or CD ROM, along with a description of the collection and processing of those data (e.g. monitor location, instrumentation, quality control, data processing). If meteorological conditions from representative local sites are used, the sources, sites, and dates of the data must be identified.

7. Receptor Grid

The receptor grid used in each of the different terrain regimes must be clearly explained. Any unique feature of the grid should be pointed out and explained. USGS 15' or 7.5' series topographical maps should be used to establish source locations. Source locations should be reported in UTM coordinates, along with the ground elevation at each source.

8. Urban/rural Classification

The method for selection urban or rural dispersion coefficients should be described.

C. Results

1. Good Engineering Practice Stack Height

All calculations for GEP stack height must be shown. This includes calculations for each tier of every building near the stack. Drawings to scale or other documentation of actual structure parameters must be included.

2. Cavity Analysis

Information used to perform the cavity analysis must be shown, including data on all appropriate structures and tiers.

3. Simple Terrain Modeling

All results of simple terrain modeling for the downwash cavity and wake effects must be presented.

4. Complex Terrain Modeling

The results of complex terrain modeling results must be presented.

5. Tables

Tables comparing cavity, simple terrain, intermediate, and complex terrain results with the AAL and CAAL must be included.

D. Documentation

In addition to the documentation requirements already presented, modeling input and output files must be appended to the report and submitted on either computer diskette or CD. Copies of all runs must be included, not only those for which worst case results are presented. Each set of output must be identified (e.g. simple or complex terrain, single or multiple emissions sources, pollutants, etc.). Maps showing the receptor grid used must also be included.

7.0 REFERENCES

1. U.S. EPA, Guideline On Air Quality Models (Revised), EPA-450/2-78-027R including Supplements A, B, and C, Research Triangle Park, NC, August 1995.
2. U.S. EPA, Guideline for Determination of Good Engineering Practice Stack Height (Revised), EPA-450/4-80-023R, Research Triangle Park, NC, June 1985.
3. U.S. EPA, "Stack Height Regulations; Final Rule", 50 Federal Register 27892, July 8, 1985, 40 CFR 51.
4. U.S. EPA, User's Guide to the Building Profile Input Program, Research Triangle Park, NC, October 1993.
5. U.S. EPA, Screening Procedures for Estimating the Air Quality Impact of Stationary Sources-Revised, EPA-450/R-92-019, Research Triangle Park, NC, October 1992.
6. U.S. EPA, "Proposal for Calculating Plume Rise for Stacks with Horizontal Releases or Rain Caps for Lookson Pigment, Newark, NJ." Memo from Joseph Tikvart, Chief, Source Receptor Analysis Branch to EPA Region II, Research Triangle Park, NC, July 9, 1993.
7. U.S. EPA, SCREEN3 Model User's Guide, EPA-450/4-92-006, Research Triangle Park, NC, September 1992.
8. U.S. EPA, Workbook of Screening Techniques for Assessing Impacts of Toxic Air Pollutants-Revised, EPA-454/R-92-024, Research Triangle Park, NC, December 1992.

APPENDIX A
**REGULATION No. 22 ACCEPTABLE AMBIENT LEVELS (AALs) (Table I) and
AALs FOR SOURCES WITH THE LOWEST ACHIEVABLE EMISSIONS RATE
(LAER) (Table II)**

Table I Acceptable Ambient Levels (AALs) ($\mu\text{g}/\text{m}^3$)				
CHEMICAL NAME	CAS #	1 hour	24 hour	Annual
Acetaldehyde	75070			0.5
Acetamide	60355			0.05
Acetone	67641	60,000	30,000	
Acetonitrile	75058		60	
Acetophenone	98862		300	
2-Acetylaminofluorene	53963			0.0008
Acrolein	107028	0.1	0.02	
Acrylamide	79061			0.0008
Acrylic Acid	79107	6,000	1	
Acrylonitrile	107131	200		0.01
Aldrin	309002	7	0.1	0.00002
Allyl Chloride	107051		1	
2-Aminoanthraquinone	117793			0.1
4-Aminobiphenyl	92671			0.0002
Ammonia	7664417	1,000		100
Aniline	62533		1	0.6
o-Anisidine	90040			0.02
Antimony & compounds, except trioxide ^a			0.2	
Antimony trioxide			0.2	0.02
Aramite	140578			0.1
Arsenic & compounds ^a (inorganic)	7440382	0.2		0.0002
Arsine	7784421	200	0.05	
Asbestos	1332214			4 ^b
Azobenzene	103333			0.03
Barium	7440393		200	
Benzene	71432	200	30	0.1
Benzidine	92875			0.00002
Benzoic acid	65850		10,000	
Benzotrichloride	98077			0.0003
Benzyl chloride	100447	200		0.02
Beryllium & compounds ^a			0.02	0.0004
Biphenyl	92524		200	
Bis (chloromethyl) ether	542881		1	0.00002
Bis (2-ethylhexyl) phthalate (DEHP)	117817		70	0.4
Boron and borates			30	
Bromates (including Potassium bromate)			10	0.007
Bromine & compounds (except Hydrogen bromide & Bromates)				2
Bromodichloromethane	75274	100	70	0.03

Table I Acceptable Ambient Levels (AALs) ($\mu\text{g}/\text{m}^3$)				
CHEMICAL NAME	CAS #	1 hour	24 hour	Annual
Bromoform	75252	2,000	70	0.9
1,3-Butadiene	106990			0.03
Butyl benzyl phthalate	85687		700	
Cadmium & compounds ^a			0.1	0.0006
Calcium cyanamide	156627			1
Captan	133062		500	1
Carbaryl	63252		300	
Carbon disulfide	75150	6,000		700
Carbon tetrachloride	56235	1,000	300	0.07
Carbonyl sulfide	463581	200		30
Catechol	120809	6000		5
Chloramben	133904		50	
Chlordane	57749		0.7	0.001
Chlorinated paraffins (avg length C12- C13, 60% chlorine)	108171262			0.04
Chlorine	7782505	200		0.2
Chlorine dioxide	10049044			0.2
Chloroacetic acid	79118		70	0.00002
2-Chloroacetophenone	532274		0.03	
4-Chloroaniline	106478		10	1
Chlorobenzene	108907			1,000
Chlorobenzilate	510156		70	0.7
1-Chloro-1,1-difluoroethane (CFC 142B)	75683		50,000	
Chlorodifluoromethane (HCFC-22)	75456		50,000	
Chloroform	67663	100 ⁱ		0.2
Chloromethyl methyl ether	107302			0.001
2-Chlorophenol	95578		20	
4-Chloro-o-phenylenediamine	95830			0.2
Chloropicrin	76062	30		0.4
Chloroprene	126998			1
p-Chloro-o-toluidine	95692			0.01
Chromium III & compounds ^a (insoluble salts)			5,000	
Chromium VI & compounds ^a - mists and aerosols			0.008	0.00008
Chromium VI & compounds ^a – solid particulate			1	0.00008
Cobalt & compounds ^a				0.01
Coke oven emissions	8007452			0.002
Copper & compounds ^a (except Copper cyanide)		100		2
p-Cresidine	120718			0.02
Cresols/Cresylic acid, isomers and mixtures (Methylphenols)	1319773			600

Table I Acceptable Ambient Levels (AALs) ($\mu\text{g}/\text{m}^3$)				
CHEMICAL NAME	CAS #	1 hour	24 hour	Annual
Cumene	98828		400	
Cupferron	135206			0.02
Cyanide & compounds (inorganic), except Hydrogen cyanide		300		9
Cyclohexane	110827		6,000	
2,4-Diaminoanisoie	615054			0.2
2,4-Diaminotoluene	95807			0.0009
Diazomethane	334883			0.8
Dibromochloromethane	124481	100	70	
1,2-Dibromo-3-chloropropane	96128		0.2	0.0005
Dibutylphthalate	84742	2,000	300	
1,2-Dichlorobenzene	95501		300	
1,4-Dichlorobenzene (p-Dichlorobenzene)	106467	5,000	800	0.09
3,3'-Dichlorobenzidene	91941			0.003
Dichloro diphenyl dichloroethylene (DDE)	3547044			0.01
cis- 1,2-Dichloroethene	156592	3,000	1,000	
trans- 1,2-Dichloroethene	156605	800	70	
Dichloroethyl ether (Bis (chloroethyl) ether)	111444		100	0.003
2,4-Dichlorophenoxyacetic acid	94757		30	
1,3-Dichloropropene	542756		20	0.2
Dichlorvos	62737	20	3	0.01
Dieldrin	60571		0.2	0.0002
Diethanolamine	111422			3
Diethyl sulfate	64675			0.003
1,1-Difluoroethane (HCFC 152a)	75376		40,000	
3,3'-Dimethoxybenzidine	119904			0.0005
p-Dimethyl aminoazobenzene	60177			0.0008
n,n-Dimethyl aniline	121697		7	
3,3'-Dimethyl benzidine	119937			0.0002
Dimethyl carbamoyl chloride	79447			0.0003
Dimethyl formamide	68122			30
1,1-Dimethyl hyrazine	57147		0.5	0.001
1,2-Dimethyl hyrazine	540738		3	0.000006
2,4-Dimethylphenol	105679		70	
Dimethyl phthalate	131113			10
Dimethyl sulfate	77781			0.0002
4,6-Dinitro-o-cresol	534521	10		
2,4-Dinitrophenol	51285	30	7	
2,4-Dinitrotoluene	121142	200	7	0.01
1,4-Dioxane (1,4-Diethyleneoxide)	123911	3,000		0.1

Table I Acceptable Ambient Levels (AALs) ($\mu\text{g}/\text{m}^3$)				
CHEMICAL NAME	CAS #	1 hour	24 hour	Annual
1,2-Diphenylhydrazine (Hydrazobenzene)	122667			0.005
Epichlorohydrin	106898	1,000		0.8
1,2-Epoxybutane	106887			2
Ethyl acrylate	140885			0.5
Ethyl benzene	100414		1,000	
Ethyl carbamate (Urethane)	51796			0.003
Ethyl chloride (Chloroethane)	75003	40,000	10,000	
Ethylene dibromide (Dibromoethane)	106934			0.005
Ethylene dichloride (1,2-Dichloroethane)	107062			0.04
Ethylene glycol	107211	1,000		400
Ethylene glycol monobutyl ether	111762	10,000		1,000
Ethylene glycol monoethyl ether	110805	400	200	70
Ethylene glycol monoethyl ether acetate	111159	100		
Ethylene glycol monomethyl ether	109864	90		20
Ethylene glycol monomethyl ether acetate	110496			90
Ethylene imine (Aziridine)	151564			0.00005
Ethylene oxide	75218		200	0.01
Ethylene thiourea	96457			0.08
Ethylidene dichloride (1,1-Dichloroethane)	75343			0.6
Fluorides & compounds, including Hydrogen fluoride		20	3	
Formaldehyde	50000	50	40	0.08
Glutaraldehyde	111308			0.08
Heptachlor	76448		2	0.00008
Hexachlorobenzene	118741	30	0.4	0.0002
Hexachlorobutadiene	87683		0.7	
Hexachlorocyclohexanes, technical grade & mixed isomers	608731			0.002
alpha-Hexachlorocyclohexane	319846			0.0006
beta-Hexachlorocyclohexane	319857	700	2	0.002
gamma-Hexachlorocyclohexane (Lindane)	58899	40	0.04	0.003
Hexachlorocyclopentadiene	77474		100	0.2
Hexachloroethane	67721	60,000		0.3
Hexamethylene-1,6-diisocyanate	822060		0.2	0.03
Hexamethylphosphoramide	680319			0.00005
Hexane	110543			200
Hydrazine	302012		5	0.0002
Hydrochloric acid (Hydrogen chloride)	7647010	2,000		9
Hydrogen bromide	10035106			20
Hydrogen cyanide	74908	300		3

Table I Acceptable Ambient Levels (AALs) ($\mu\text{g}/\text{m}^3$)				
CHEMICAL NAME	CAS #	1 hour	24 hour	Annual
Hydrogen sulfide	7783064	40		10
Hydroquinone	123319		1,000	5
Isophorone	78591		700	4
Isopropanol	67630	3,000		
Lead & compounds ^a , inorganic				0.008
Lead – tetraethyl lead	78002		0.00003	
Maleic anhydride	108316	10		0.7
Manganese & compounds ^a			0.05	0.04
Mercury & compounds. ^a – elemental & inorganic, except Mercuric chloride		2	0.3	0.009
Mercury - methylmercury	22967926		0.3	0.003
Methanol	67561	30,000		4,000
Methoxychlor	72435		20	
Methyl bromide (Bromomethane)	74839	200		5
Methyl chloride (Chloromethane)	74873	1,000	400	90
Methyl chloroform (1,1,1-Trichloroethane)	71556	10,000	4,000	1,000
4,4-Methylene bis (2-chloroaniline)	101144			0.002
Methylene chloride (Dichloromethane)	75092	2,000	1,000	2
4,4-Methylenedianiline	101779	700	300	0.002
Methylene diphenyl diisocyanate	101688			0.6
Methyl ethyl ketone (2-Butanone)	78933	10,000	5,000	
Methyl hydrazine	60344			0.0004
Methyl iodide (Iodomethane)	74884	4,000		30
Methyl isobutyl ketone (Hexanone)	108101		3,000	
Methyl isocyanate	624839			1
Methyl methacrylate	80626		700	
Methyl tert butyl ether (MTBE)	1634044	7,000	3,000	
Michler's ketone (4,4'-Bis (dimethylamino) benzophenone)	90948			0.004
Fine mineral fibers ^c				20
Molybdenum & compounds ^a			20	
Naphthalene	91203			0.3
Nickel and compounds ^a , except Nickel subsulfide		6		0.004
Nickel subsulfide	12035722	6		0.002
Nitric acid	7697372	90		
Nitrobenzene	98953			2
4-Nitrobiphenyl	92933			0.00002
4-Nitrophenol	100027			0.1
2-Nitropropane	79469		20	0.1
N-Nitrosodi-n-butylamine	924163			0.0006

Table I Acceptable Ambient Levels (AALs) ($\mu\text{g}/\text{m}^3$)				
CHEMICAL NAME	CAS #	1 hour	24 hour	Annual
N-Nitrosodiethylamine	55185			0.00002
N-Nitrosodimethylamine	62759			0.00007
N-Nitrosodiphenylamine	86306			0.4
N-Nitrosdi-n-propylamine	621647	300		0.0005
N-Nitroso-n-methylethylamine	10595956			0.0002
N-Nitroso-n-methylurea	684935			0.00003
N-Nitrosomorpholine	59892			0.0005
N-Nitrosopiperidine	100754			0.0004
N-Nitrosopyrrolidine	930552			0.002
Parathion	56382		20	0.2
Pentachloronitrobenzene (Quintozene)	82688		10	
Pentachlorophenol	87865	20	4	0.2
Phenol	108952	6,000		200
p-Phenylenediamine	106503			0.2
Phosgene	75445	4		
Phosphine	7803512			0.3
Phosphoric acid	7664382			7
Phosphorus	7723140	20	0.07	
Phthalic anhydride	85449		7,000	20
Polychlorinated biphenyls (PCBs), except Aroclor 1254	1336363		0.2	0.001
PCBs- Aroclor 1254	11097691		0.07	
Polychlorinated dibenzo dioxins (PCDDs), Polychlorinated dibenzo furans (PCDFs) and dioxin-like Polychlorinated biphenyls (PCBs)				$3 \times 10^{-9}^{\text{d}}$
Polycyclic Organic Matter				0.00009 ^e
1,3-Propane sultone	1120714			0.001
beta-Propiolactone	57578			0.0002
Propionaldehyde	123386			100
Propoxur (Baygon)	114261		10	0.1
Propylene	115071			3,000
Propylene dichloride (1,2-Dichloropropane)	78875	200	4	0.1
Propylene glycol monomethyl ether (PGME)	107982			7,000
Propylene oxide	75569	3,000		0.3
1,2-Propylenimine (2-Methyl aziridine)	75558			0.0001
Quinoline	91225			0.001
Quinone	106514			1
Selenium & compounds ^a , except Hydrogen selenide and Selenium sulfide				20
Selenium – Hydrogen selenide	7783075	5		

Table I Acceptable Ambient Levels (AALs) ($\mu\text{g}/\text{m}^3$)				
CHEMICAL NAME	CAS #	1 hour	24 hour	Annual
Selenium sulfide	7446346		20	0.2
Sodium hydroxide	1310932	8		5
Styrene	100425	20,000	1,000	100
Styrene oxide	96093			0.02
Sulfates ^f		100		20
Sulfuric acid and Oleum ^g		100		1
1,1,1,2-Tetrachloroethane	630206		100	
1,1,2,2-Tetrachloroethane	79345		3,000	
Tetrachloroethylene (Perchloroethylene)	127184	1,000		0.2
Tetrachlorophenols	25167833			90
1,1,1,2-Tetrafluoroethane	811972		80,000	
Thioacetamide	62555			0.0006
Titanium tetrachloride	7550450		10	0.1
Toluene	108883	4,000	400	300
2,4-Toluene diamine (2,4-Diaminotoluene)	95807			0.0009
2,4-and 2,6-Toluene diisocyanate ^h	26471625			0.07
o-Toluidine	95534			0.02
Toxaphene (Chlorinated camphene)	8001352	20	4	0.0003
1,2,4-Trichlorobenzene	120821		30	
1,1,2-Trichloroethane	79005		10	
Trichloroethylene	79016	10,000	500	0.5
Trichlorofluoromethane	75694		1,000	
2,4,5-Trichlorophenol	95954		300	
2,4,6-Trichlorophenol	88062			0.3
Triethylamine	121448	3,000		7
Trifluralin	1582098		30	3
2,2,4-Trimethylpentane	540841			200
Vanadium & compounds ^a		0.2		
Vinyl acetate	108054		200	20
Vinyl bromide	593602		3	0.005
Vinyl chloride	75014	1,000	100	0.2
Vinylidene chloride (1,1-Dichloroethylene)	75354		200	70
Xylenes, isomers and mixtures	1330207	4,000	3,000	100
Zinc & compounds ^a			1,000	30

^aFor metal compounds, concentrations apply to the metal portion of the compound.

^bAsbestos units are fibers/cubic meter.

^cFine mineral fibers are mineral fiber emissions from facilities manufacturing or processing glass, rock, or slag fibers or other mineral derived fibers of average diameter 1-micrometer (μm) or less.

^dPCDD AAL is in terms of 2,3,7,8-tetrachlorodibenzodioxin equivalents, calculated as specified in the Rhode Island Air Toxics Guideline.

^cPolycyclic Organic Matter AAL is in terms of benzo(a)pyrene equivalents, calculated as specified in the Rhode Island Air Toxics Guideline.[”]

^fSulfates AALs apply to ammonium bisulfate [(NH₄)HSO₄, CAS 7803-63-6], ammonium sulfate [(NH₄)₂SO₄, CAS 7783-20-2], ferric sulfate [Fe(SO₄)₃, CAS 10028-22-5] and sodium sulfate [Na₂SO₄, CAS 7757-82-6]

^gSulfuric acid and oleum AALs apply to sulfuric acid (H₂SO₄, CAS 7664-03-9), sulfur trioxide (SO₃, CAS 7446-71-9) and oleum (H₂SO₄ + SO₃, CAS 8014-95-7)

^hIncludes 2,4-TDI (CAS 584849), 2,6-TDI (CAS 91087) and 2,4/2,6 mixtures (CAS 26471625)

Table II Acceptable Ambient Levels (AALs) with LAER (µg/m³)				
CHEMICAL NAME	CAS #	1 hour	24 hour	Annual
Acetaldehyde	75070			5
Acetamide	60355			0.5
Acetone	67641	60,000	30,000	
Acetonitrile	75058		60	
Acetophenone	98862		300	
2-Acetylaminofluorene	53963			0.008
Acrolein	107028	0.1	0.02	
Acrylamide	79061			0.008
Acrylic Acid	79107	6,000	1	
Acrylonitrile	107131	200		0.1
Aldrin	309002	7	0.1	0.0002
Allyl Chloride	107051		1	
2-Aminoanthraquinone	117793			1
4-Aminobiphenyl	92671			0.002
Ammonia	7664417	1,000		100
Aniline	62533		1	
o-Anisidine	90040			0.2
Antimony & compounds ^a , except trioxide			0.2	
Antimony trioxide			0.2	0.02
Aramite	140578			1
Arsenic & compounds ^a (inorganic)		0.2		0.002
Arsine	7784421	200	0.05	
Asbestos	1332214			40 ^b
Azobenzene	103333			0.3
Barium	7440393		200	
Benzene	71432	200	30	1
Benzidine	92875			0.0002
Benzoic acid	65850		1,000	
Benzotrichloride	98077			0.003
Benzyl chloride	100447	200		0.2
Beryllium & compounds ^a			0.02	0.004

Table II Acceptable Ambient Levels (AALs) with LAER ($\mu\text{g}/\text{m}^3$)				
CHEMICAL NAME	CAS #	1 hour	24 hour	Annual
Biphenyl	92524		200	
Bis (chloromethyl) ether	542881		1	0.0002
Bis (2-ethylhexyl) phthalate (DEHP)	117817		70	4
Boron and borates			30	
Bromates (including Potassium bromate)			10	0.07
Bromine & compounds (except Hydrogen bromide & Bromates)				2
Bromodichloromethane	75274	100	70	0.3
Bromoform	75252	2,000	70	9
1,3-Butadiene	106990			0.3
Butyl benzyl phthalate	85687		700	
Cadmium & compounds ^a			0.1	0.006
Calcium cyanamide	156627			1
Captan	133062		500	10
Carbaryl	63252		300	
Carbon disulfide	75150	6,000		700
Carbon tetrachloride	56235	1,000	300	0.7
Carbonyl sulfide	463581	200		30
Catechol	120809	6000		5
Chloramben	133904		50	
Chlordane	57749		0.7	0.01
Chlorinated paraffins (avg length C12- C13, 60% chlorine)	108171262			0.4
Chlorine	7782505	200		0.2
Chlorine dioxide	10049044			0.2
Chloroacetic acid	79118		70	0.00002
2-Chloroacetophenone	532274		0.03	
4-Chloroaniline	106478		10	1
Chlorobenzene	108907			1,000
Chlorobenzilate	510156		70	0.7
1-Chloro-1,1-difluoroethane (CFC 142B)	75683		50,000	
Chlorodifluoromethane (HCFC-22)	75456		50,000	
Chloroform	67663	100 ⁱ		2
Chloromethyl methyl ether	107302			0.01
2-Chlorophenol	95578		20	
4-Chloro-o-phenylenediamine	95830			2
Chloropicrin	76062	30		0.4
Chloroprene	126998			1
p-Chloro-o-toluidine	95692			0.1
Chromium III & compounds ^a (insoluble salts)			5,000	

Table II Acceptable Ambient Levels (AALs) with LAER ($\mu\text{g}/\text{m}^3$)				
CHEMICAL NAME	CAS #	1 hour	24 hour	Annual
Chromium VI & compounds ^a - mists and aerosols			0.008	0.0008
Chromium VI & compounds ^a – solid particulate			1	0.0008
Cobalt & compounds ^a				0.01
Coke oven emissions ^a	8007452			0.02
Copper & compounds ^a (except Copper cyanide)		100		2
p-Cresidine	120718			0.2
Cresols/Cresylic acid, isomers and mixtures (Methylphenols)	1319773			600
Cumene	98828		400	
Cupferron	135206			0.2
Cyanide & compounds (inorganic), except Hydrogen cyanide		300		9
Cyclohexane	110827		6,000	
2,4-Diaminoanisole	615054			2
2,4-Diaminotoluene	95807			0.009
Diazomethane	334883			0.8
Dibromochloromethane	124481	100	70	
1,2-Dibromo-3-chloropropane	96128		0.2	0.005
Dibutylphthalate	84742	2,000	300	
1,2-Dichlorobenzene	95501		300	
1,4-Dichlorobenzene (p-Dichlorobenzene)	106467	5,000	800	0.9
3,3'-Dichlorobenzidine	91941			0.03
Dichloro diphenyl dichloroethylene (DDE)	3547044			0.1
cis- 1,2-Dichloroethene	156592	3,000	1,000	
trans- 1,2-Dichloroethene	156605	800	70	
Dichloroethyl ether (Bis (chloroethyl) ether)	111444		100	0.03
2,4-Dichlorophenoxyacetic acid	94757		30	
1,3-Dichloropropene	542756		20	2
Dichlorvos	62737	20	3	0.1
Dieldrin	60571		0.2	0.002
Diethanolamine	111422			3
Diethyl sulfate	64675			0.03
1,1-Difluoroethane (HCFC 152a)	75376		40,000	
3,3'-Dimethoxybenzidine	119904			0.005
p-Dimethyl aminoazobenzene	60177			0.008
n,n-Dimethyl aniline	121697		7	
3,3'-Dimethyl benzidine	119937			0.002
Dimethyl carbamoyl chloride	79447			0.003
Dimethyl formamide	68122			30
1,1-Dimethyl hyrazine	57147		0.5	0.01

Table II Acceptable Ambient Levels (AALs) with LAER ($\mu\text{g}/\text{m}^3$)				
CHEMICAL NAME	CAS #	1 hour	24 hour	Annual
1,2-Dimethyl hyrazine	540738		3	0.00006
2,4-Dimethylphenol	105679		70	
Dimethyl phthalate	131113			10
Dimethyl sulfate	77781			0.002
4,6-Dinitro-o-cresol	534521	10		
2,4-Dinitrophenol	51285	30	7	
2,4-Dinitrotoluene	121142	200	7	0.1
1,4-Dioxane (1,4-Diethyleneoxide)	123911	3,000		1
1,2-Diphenylhydrazine (Hydrazobenzene)	122667			0.05
Epichlorohydrin	106898	1,000		
1,2-Epoxybutane	106887			2
Ethyl acrylate	140885			0.5
Ethyl benzene	100414		1,000	
Ethyl carbamate (Urethane)	51796			0.03
Ethyl chloride (Chloroethane)	75003	40,000	10,000	
Ethylene dibromide (Dibromoethane)	106934			0.05
Ethylene dichloride (1,2-Dichloroethane)	107062			0.4
Ethylene glycol	107211	1,000	7000	400
Ethylene glycol monobutyl ether	111762	10,000		1,000
Ethylene glycol monoethyl ether	110805	400	200	70
Ethylene glycol monoethyl ether acetate	111159	100		
Ethylene glycol monomethyl ether	109864	90		20
Ethylene glycol monomethyl ether acetate	110496			90
Ethylene imine (Aziridine)	151564			0.0005
Ethylene oxide	75218		200	0.1
Ethylene thiourea	96457			0.8
Ethylidene dichloride (1,1-Dichloroethane)	75343			6
Fluorides & compounds, including Hydrogen fluoride		20	3	
Formaldehyde	50000	50	40	0.8
Glutaraldehyde	111308			0.08
Heptachlor	76448		2	0.0008
Hexachlorobenzene	118741	30	0.4	0.002
Hexachlorobutadiene	87683		0.7	
Hexachlorocyclohexanes, technical grade & mixed isomers	608731			0.02
alpha-Hexachlorocyclohexane	319846			0.006
beta-Hexachlorocyclohexane	319857	700	2	0.02
gamma-Hexachlorocyclohexane (Lindane)	58899	40	0.04	0.03
Hexachlorocyclopentadiene	77474		100	0.2

Table II Acceptable Ambient Levels (AALs) with LAER ($\mu\text{g}/\text{m}^3$)				
CHEMICAL NAME	CAS #	1 hour	24 hour	Annual
Hexachloroethane	67721	60,000		3
Hexamethylene-1,6-diisocyanate	822060		0.2	0.03
Hexamethylphosphoramide	680319			0.0005
Hexane	110543			200
Hydrazine	302012		5	0.002
Hydrochloric acid (Hydrogen chloride)	7647010	2,000		9
Hydrogen bromide	10035106			20
Hydrogen cyanide	74908	300		3
Hydrogen sulfide	7783064	40		10
Hydroquinone	123319		1,000	5
Isophorone	78591		700	
Isopropanol	67630	3,000		
Lead & compounds ^a , inorganic				0.08
Lead – tetraethyl lead	78002		0.0003	
Maleic anhydride	108316	10		0.7
Manganese & compounds ^a			0.05	0.04
Mercury & cmpds. – elemental & inorganic, except Mercuric chloride		2	0.3	0.009
Mercury - methylmercury	22967926		0.3	0.003
Methanol	67561	30,000		4,000
Methoxychlor	72435		20	
Methyl bromide (Bromomethane)	74839	200		5
Methyl chloride (Chloromethane)	74873	1,000	400	90
Methyl chloroform (1,1,1-Trichloroethane)	71556	10,000	4,000	1,000
4,4-Methylene bis (2-chloroaniline)	101144			0.02
Methylene chloride (Dichloromethane)	75092	2,000	1,000	20
4,4-Methylenedianiline	101779	700	300	0.02
Methylene diphenyl diisocyanate	101688			0.6
Methyl ethyl ketone (2-Butanone)	78933	10,000	5,000	
Methyl hydrazine	60344			0.004
Methyl iodide (Iodomethane)	74884	4,000		30
Methyl isobutyl ketone (Hexanone)	108101		3,000	
Methyl isocyanate	624839			1
Methyl methacrylate	80626		700	
Methyl tert butyl ether (MTBE)	1634044	7,000	3,000	
Michler's ketone (4,4'-Bis (dimethylamino) benzophenone)	90948			0.04
Fine mineral fibers ^c				20
Molybdenum & compounds ^a			20	
Naphthalene	91203			0.3

Table II Acceptable Ambient Levels (AALs) with LAER ($\mu\text{g}/\text{m}^3$)				
CHEMICAL NAME	CAS #	1 hour	24 hour	Annual
Nickel and compounds ^a , except Nickel subsulfide	7440020	6		0.04
Nickel subsulfide	12035722	6		0.02
Nitric acid	7697372	90		
Nitrobenzene	98953			2
4-Nitrobiphenyl	92933			0.00002
4-Nitrophenol	100027			0.1
2-Nitropropane	79469		20	1
N-Nitrosodi-n-butylamine	924163			0.006
N-Nitrosodiethylamine	55185			0.0002
N-Nitrosodimethylamine	62759			0.0007
N-Nitrosodiphenylamine	86306			4
N-Nitrosdi-n-propylamine	621647	30		0.005
N-Nitroso-n-methylethylamine	10595956			0.002
N-Nitroso-n-methylurea	684935			0.0003
N-Nitrosomorpholine	59892			0.005
N-Nitrosopiperidine	100754			0.004
N-Nitrosopyrrolidine	930552			0.02
Parathion	56382		20	0.2
Pentachloronitrobenzene (Quintozone)	82688		10	
Pentachlorophenol	87865	20	4	2
Phenol	108952	6,000		200
p-Phenylenediamine	106503			0.2
Phosgene	75445	4		
Phosphine	7803512			0.3
Phosphoric acid	7664382			7
Phosphorus	7723140	20	0.07	
Phthalic anhydride	85449		7000	20
Polychlorinated biphenyls (PCBs), except Aroclor 1254	1336363		0.02	0.01
PCBs- Aroclor 1254	11097691		0.07	
Polychlorinated dibenzo dioxins (PCDDs), Polychlorinated dibenzo furans (PCDFs) and dioxin-like Polychlorinated biphenyls (PCBs)				$3 \times 10^{-8}^d$
Polycyclic Organic Matter				0.0009^e
1,3-Propane sultone	1120714			0.01
beta-Propiolactone	57578			0.002
Propionaldehyde	123386			100
Propoxur (Baygon)	114261		10	0.1
Propylene	115071			3,000
Propylene dichloride (1,2-Dichloropropane)	78875	200	4	1

Table II Acceptable Ambient Levels (AALs) with LAER ($\mu\text{g}/\text{m}^3$)				
CHEMICAL NAME	CAS #	1 hour	24 hour	Annual
Propylene glycol monomethyl ether (PGME)	107982			7,000
Propylene oxide	75569	3,000		3
1,2-Propylenimine (2-methyl aziridine)	75558			0.001
Quinoline	91225			0.01
Quinone	106514			1
Selenium & compounds ^a , except Hydrogen selenide and Selenium sulfide				20
Selenium – Hydrogen selenide	7783075	5		
Selenium sulfide	7446346		20	0.2
Sodium hydroxide	1310932	8		5
Styrene	100425	20,000	1,000	100
Styrene oxide	96093			0.2
Sulfates ^f		100		20
Sulfuric acid and Oleum ^g	7664939	100		1
1,1,1,2-Tetrachloroethane	630206		100	
1,1,2,2-Tetrachloroethane	79345		3,000	
Tetrachloroethylene (Perchloroethylene)	127184	1,000		2
Tetrachlorophenols	25167833			90
1,1,1,2-Tetrafluoroethane	811972		80,000	
Thioacetamide	62555			0.006
Titanium tetrachloride	7550450		10	0.1
Toluene	108883	4,000	400	300
2,4-Toluene diamine (2,4-Diaminotoluene)	95807			0.009
2,4-and 2,6-Toluene diisocyanate ^h	26471625			0.07
o-Toluidine	95534			0.2
Toxaphene (Chlorinated camphene)	8001352	20	4	0.003
1,2,4-Trichlorobenzene	120821		30	
1,1,2-Trichloroethane	79005		10	
Trichloroethylene	79016	10,000	500	5
Trichlorofluoromethane	75694		1,000	
2,4,5-Trichlorophenol	95954		300	
2,4,6-Trichlorophenol	88062			3
Triethylamine	121448	3,000		7
Trifluralin	1582098		30	3
2,2,4-Trimethylpentane	540841			200
Vanadium & compounds ^a		0.2		
Vinyl acetate	108054		200	20
Vinyl bromide	593602		3	0.05
Vinyl chloride	75014	1,000	100	2
Vinylidene chloride (1,1-Dichloroethylene)	75354		200	70

Table II Acceptable Ambient Levels (AALs) with LAER ($\mu\text{g}/\text{m}^3$)				
CHEMICAL NAME	CAS #	1 hour	24 hour	Annual
Xylenes, isomers and mixtures	1330207	4,000	3,000	100
Zinc & compounds ^a			1,000	30

^aFor metal compounds, concentrations apply to the metal portion of the compound.

^bAsbestos units are fibers/cubic meter.

^cFine mineral fibers are mineral fiber emissions from facilities manufacturing or processing glass, rock, or slag fibers or other mineral derived fibers of average diameter 1 micrometer (μm) or less.

^dPCDD AAL is in terms of 2,3,7,8-tetrachlorodibenzodioxin equivalents, calculated as specified in the Rhode Island Air Toxics Guideline.

^ePolycyclic Organic Matter AAL is in terms of benzo(a)pyrene equivalents, calculated as specified in the Rhode Island Air Toxics Guideline.

^fSulfates AALs apply to ammonium bisulfate $[(\text{NH}_4)\text{HSO}_4]$, CAS 7803-63-6], ammonium sulfate $[(\text{NH}_4)_2\text{SO}_4]$, CAS 7783-20-2], ferric sulfate $[\text{Fe}(\text{SO}_4)_3]$, CAS 10028-22-5] and sodium sulfate $[\text{Na}_2\text{SO}_4]$, CAS 7757-82-6]

^gSulfuric acid and oleum AALs apply to sulfuric acid (H_2SO_4 , CAS 7664-03-9), sulfur trioxide (SO_3 , CAS 7446-71-9) and oleum ($\text{H}_2\text{SO}_4 + \text{SO}_3$, CAS 8014-95-7)

^hIncludes 2,4-TDI (CAS 584849), 2,6-TDI (CAS 91087) and 2,4/2,6 mixtures (CAS 26471625)

APPENDIX B

CHECKLIST FOR REFINED MODELING

CONTROL PARAMETERS

1. Model Selection

An appropriate model must be chosen. AERMOD-PRIME is appropriate for almost all refined modeling. Effective July 1, 2005 AERMOD-PRIME must be selected for refined modeling of air toxics. Prior to this date approval from this Office to use other models will be required.

2. Averaging Time

The averaging period must be the same as that used for the AAL of interest.

3. Urban/Rural Classification

The urban/rural designation must be confirmed through review of topographic maps.

4. Terrain Type

The default regulatory option in AERMOD-PRIME must be selected for all refined modeling runs.

SOURCE PARAMETERS

1. Emission Rate

The emission rate must be correct and in the appropriate units.

2. Source Location

A site plan should be used to confirm that the coordinates of the source(s) are correct.

3. Base Elevation

A topographic map should be used to confirm that the base elevation of the source(s) is correct.

4. Stack Height and Release Height

The heights for all stacks and other releases must be measured from the same ground elevation point.

5. Stack Exit Temperature

Confirm that the stack exit temperature is correctly computed in degrees Kelvin.

6. Stack Exit Diameter

The exit diameter must be the inside diameter at the top of the stack.

7. Flow Rate/Exit Velocity

The flow rate through the stacks must be confirmed. The calculation of exit velocity must be confirmed from the diameter and flow rate values.

8. Stack Conditions

Traditional point sources are vertically-emitting, unobstructed and have a release height greater than 1.2 times the building on which they are placed. Special allowances must be made for horizontal stacks and stacks with rain caps (Section 5.3). Stacks with effective heights less than 1.2 times the height of the building on which they are placed might have to be treated as volume sources.

9. Building Downwash

A GEP analysis must be performed in order to determine if building downwash effects are possible around a source. If downwash is possible, the appropriate building dimensions must be used in the modeling.

10. Initial Dimensions for Volume and Area Sources

The initial lateral and vertical dimensions for volume sources and initial lateral dimension for area sources must be confirmed.

11. Source Groups

All sources must be accounted for in the output.

RECEPTOR GRID

1. Receptor Locations

The receptor grid must extend beyond the property boundary and the receptors must extend far enough and be spaced close enough together to ensure that the maximum impact is predicted. Receptor spacing should never be greater than 200 meters.

2. Receptor Elevations

A topographic map should be used to check that the receptor elevations are correct.

3. Grid Orientation

The receptor grid must be oriented exactly to true north.

METEOROLOGICAL PARAMETERS

1. Input File

The input file must match the year being modeled and must contain average hourly meteorological data.

2. Meteorological Data Station

The meteorological data station must be either that at Green State Airport, a representative meteorological site, or located on-site. The anemometer height must be correctly entered in the modeling input file. The anemometer at Green State Airport is at **6.1 m.**

OUTPUT

1. Invalid Receptors

For AERMOD-PRIME runs, the model output must be checked for invalid receptors, i.e., within $3L_b$ of the source. These receptors must be eliminated from consideration.

2. Maximum Off-Property Impact

The maximum off-property impact from five years of meteorological data must be confirmed by reviewing the model output.

3. Cavity Analysis

An evaluation of the source should be performed in order to determine if a cavity analysis is applicable.

4. Conversions

All conversions, e.g., from concentration per mass/time to allowable mass/time, should be checked thoroughly.